

COST STUDY DATA CHARACTERIZATION REPORT



Achieving Interoperability through Cooperation and Coordination

Fairfax, VA
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Final

BOOZ·ALLEN & HAMILTON

Foreword...

LOCAL PUBLIC SAFETY AGENCIES OPERATE A DIVERSE SET OF COMMUNICATIONS INFRASTRUCTURES

- The Public Safety Wireless Network (PSWN) Program Management Office (PMO) commissioned Booz·Allen & Hamilton to independently assess the data collected during the *Land Mobile Radio (LMR) Replacement Cost Study*
 - This report is not intended to represent trends for all local and state public safety communities, however, it is intended to reflect trends in the responses of those who completed the cost survey
 - We invite comments to verify the quality and comprehensiveness of our analysis
 - If you have comments regarding the information contained in this document, please contact the PSWN PMO at 1-800-565-PSWN or access the PSWN program Web site at: <http://www.pswn.gov>
- Booz·Allen relied on the responses provided to the *LMR Equipment and Infrastructure Survey* as the source of information for this report
 - This survey was administered primarily to collect the data necessary for estimating the replacement cost of existing public safety radio systems
 - The inventory data collected through this survey are revealing in their own right
 - The data was analyzed and represented graphically using **Microsoft Excel** and **SPSS Inc.**, a statistical analysis software package, to generate the information presented in this report

I. INTRODUCTION

Introduction...

DATA COLLECTED FROM LOCAL AND STATE PUBLIC SAFETY AGENCY RESPONSES TO SURVEYS DEVELOPED FOR THE *LAND MOBILE RADIO (LMR) REPLACEMENT COST STUDY* ARE CHARACTERIZED IN THIS REPORT

- Section II discusses the background for the *Data Characterization Report*
 - Report Evolution
 - Cost Study Overview
 - Statistical Accuracy
- Section III summarizes local public safety agency respondents' general system information
 - Demographics
 - System Type
 - Operating Frequency
 - Shared Systems
 - Additional Types of Communications Supported
- Section IV summarizes local public safety agency respondents' user equipment information
 - Portable Radio Vendors
 - Portable Radio Types
 - Portable Radio Security
 - Mobile Radio Vendors
 - Mobile Radio Types
 - Mobile Radio Security
- Section V summarizes local public safety agency respondents' network equipment information
 - Base Stations
 - Repeaters
 - Antenna Towers
 - Dispatch and Control
 - Automatic Vehicle Locator
 - Computer Aided Dispatch
 - Network Equipment Vendors

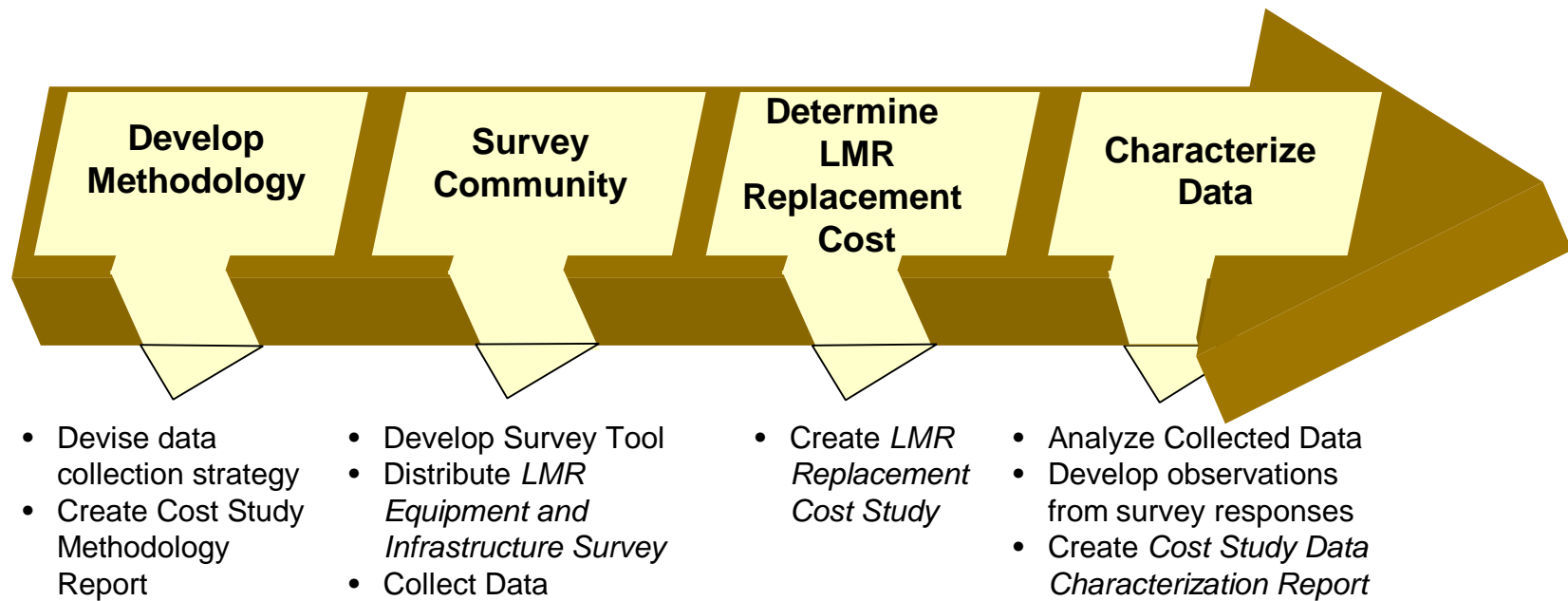
Introduction...

THE CHARACTERIZATION OF THESE DATA PROVIDES A REVEALING SNAPSHOT OF THE CURRENT INVENTORY OF LOCAL AND STATE PUBLIC SAFETY LMR EQUIPMENT AND INFRASTRUCTURE

- Section VI summarizes state public safety agency respondents' general system information
 - Demographics
 - System Type
 - Operating Frequency
 - Shared Systems
 - Additional Types of Communications Supported
- Section VII summarizes state public safety agency respondents' user equipment information
 - Portable Radio Vendors
 - Portable Radio Types
 - Portable Radio Security
 - Mobile Radio Vendors
 - Mobile Radio Types
 - Mobile Radio Security
- Section VIII summarizes state public safety agency respondents' network equipment information
 - Base Stations
 - Repeaters
 - Antenna Towers
 - Dispatch and Control
 - Automatic Vehicle Locator
 - Computer Aided Dispatch
 - Network Equipment Vendors
- The appendixes of this report provide additional background on the following areas:
 - Appendix A: Local agencies' general systems information
 - Appendix B: Local agencies' user equipment information
 - Appendix C: Local agencies' network equipment information
 - Appendix D: State agencies' general systems information
 - Appendix E: State agencies' user equipment information
 - Appendix F: State agencies' network equipment information

II. REPORT BACKGROUND

THE PSWN PROGRAM'S COST STUDY ACTIVITY CULMINATES WITH A CHARACTERIZATION OF THE DATA COLLECTED DURING A NATIONWIDE ASSESSMENT OF PUBLIC SAFETY COMMUNICATIONS INFRASTRUCTURE



THE DATA USED IN THIS REPORT WERE COLLECTED DURING THE PREPARATION OF THE *LMR REPLACEMENT COST STUDY*¹

- The methodology employed to determine the replacement cost of public safety's LMR infrastructure is detailed in the *Cost Study Methodology Report*
 - The report defines the sample needed for statistical accuracy and the method by which the study team would achieve this representative sample
- The *Cost Study* used a survey designed to gather information from public safety agencies at all levels of government regarding the type of system on which the agency operates and the type and amount of user equipment each agency possesses
 - A total of 51,385 local public safety agencies were identified for inclusion in the *Cost Study* using the *1997 National Directory of Fire Chiefs* and the *1997 National Directory of Law Enforcement Administrators*
 - The local survey used a stratified random sample that required 4,453 surveys to be distributed and approximately 445 surveys to be returned for an accurate nationwide assessment
 - Several state public safety agencies were identified using sources such as the World Wide Web
 - The cost study team distributed over 150 surveys to these state agencies, and sought a 50% response rate to achieve an accurate sample and an appropriate confidence interval
- The *LMR Replacement Cost Study* reported the total replacement value for all public safety communications systems to be **\$18.3 billion**
 - The study estimates the replacement value for local LMR systems at **\$15.4 billion**
 - The study estimates the replacement value for state LMR systems at **\$1.7 billion**
- The study estimates the replacement value for federal² LMR systems at **\$1.2 billion**

¹ The phrase "LMR Replacement Cost Study" and "Cost Study" are used interchangeable within this report

² Information was collected to estimate the replacement value of existing federal systems. This information was gathered on an agency-by-agency basis and the means used to gather the information varied by agency. Because of this, the extent and type of equipment inventory information for participating federal agencies varies significantly and does not lend itself to the statistical characterization performed in this report. Therefore, the report addresses only local and state information.

DATA CHARACTERIZED IN THIS REPORT IS REPRESENTATIVE OF THE RESPONSES FROM A STATISTICALLY DIVERSE SET OF LOCAL AND STATE AGENCIES, BUT CANNOT BE INTERPRETED TO REPRESENT THE PUBLIC SAFETY COMMUNITY AS A WHOLE

- Surveys were distributed among local agencies of varying missions in direct proportion to the overall composition of the public safety community³

	Population	Sample	Responses	Response Rate
Campus Police	2,225	174	21	12.1%
Emergency	6,897	543	94	17.3%
Fire (paid and volunteer)	29,294	2,472	433	17.5%
Municipal Police	10,307	968	288	29.8%
County Sheriff	3,132	296	81	27.4%
Total	51,837	4,453	917	20.6%

³ For purposes of the data characterization, the local agency types were combined into five agency missions: Law Enforcement, Fire, Emergency Medical Services (EMS), Combined Fire and EMS/Rescue, and All (Law Enforcement, Fire, EMS, EMS/Fire)

SURVEYS WERE DISTRIBUTED AMONG STATE AGENCIES IN AN EFFORT TO BE REPRESENTATIVE OF THE COMPOSITION OF THE OVERALL STATE PUBLIC SAFETY COMMUNITY⁴

	Sample	Responses	Response Rate
Corrections	42	24	57.8%
Emergency Management	38	14	36.8%
State Police	46	24	52.2%
Fire Marshall	7	7	100.0%
Emergency Medical Services	3	3	100.0%
Radio/IT	7	7	100.0%
Miscellaneous Public Safety	18	15	83.3%
Total	161	94	58.4%

⁴ For purposes of the data characterization, the state agency types were combined into four agency missions: Law Enforcement, Fire/EMS, Emergency Management, Department of Public Safety

III. LOCAL AGENCIES' GENERAL SYSTEMS INFORMATION

Local Agencies' General Systems Information...

THIS SECTION SUMMARIZES LOCAL AGENCY RESPONDENTS' GENERAL SYSTEMS INFORMATION

- This section covers the following set of system information
 - Local Agency Demographics
 - System Type
 - Operating Frequency
 - Shared Systems
 - Additional Types of Communications Supported

FOR THE PURPOSE OF THIS REPORT, COLLECTED LOCAL AGENCY DATA ARE PRESENTED AND ANALYZED USING THE FOLLOWING KEY DEMOGRAPHIC GROUPINGS

- Responding agencies are classified into five mission types with the following distribution:

- Law Enforcement	38.1%	- Combined Fire and EMS/Rescue	10.5%
- Fire	33.7%	- All	9.6%
- EMS/Rescue	8.1%		

- System size is determined by grouping the number of users into four groups with the following distribution:

- Less than 25 users	40.4%	- 51-100 users	13.8%
- 25-50 users	34.4%	- Greater than 100 users	11.5%

- Responding agencies are grouped into four geographic regions that were established by combining the nine United States census regions:

- East Central	25.6%	- Mountain/Pacific	16.6%
(East North Central/East South Central)		- West Central	26.4%
- East Coast	31.4%	(West North Central/West South Central)	
(Mid-Atlantic/South Atlantic/New England)			

- Agency's coverage area is determined by grouping the jurisdiction size into four groups with the following distribution:

- Less than 100 square miles	71.7%	- 1,001 – 10,000 square miles	4.7%
- 101 – 1,000 square miles	22.9%	- Greater than 10,000 square miles	0.7%

IF LMR TECHNOLOGY CONTINUES TO MOVE TOWARD DIGITAL SYSTEMS, LOCAL AGENCIES WILL NEED TO DEDICATE SIGNIFICANT FINANCIAL RESOURCES TO MODERNIZATION

- Approximately 10% of all local respondents operate digital systems
 - Of those with digital systems, 78.2% operate conventional systems and 21.8% operate trunked systems
 - Nearly 90% of all local respondents report operating analog systems
- Local respondents with large systems—systems with greater than 100 users—have the most significant investment in digital technology
 - Over 18% of responding local agencies with more than 100 users operate digital systems
 - Trunked digital systems make up less than 1% of large local systems
- Regardless of their mission, responding local agencies have not made large-scale moves to replace conventional analog technology
 - More than 80% of agencies within each mission currently operate conventional analog systems

Note: Charts showing the distribution of system types by agency mission and number of users are included in Appendix A

ALTHOUGH MORE SPECTRUM IS GENERALLY AVAILABLE IN THE 800 MHZ BAND, MANY LOCAL AGENCIES CONTINUE TO OPERATE THEIR SYSTEMS IN HIGH-BAND VHF

- Survey responses show that most local agencies operate in the High-Band VHF frequency range
 - 56.6% are in High-Band VHF while a relatively small percentage (5.9%) are in 800 MHz
- Local law enforcement is more evenly distributed throughout the four major frequency bands than either fire or EMS agencies
 - A majority of local law enforcement agencies (49.2%) are in High-Band VHF; however, a significant portion (8.5%) of local respondents indicated that they operate 800 MHz systems
 - Local fire and EMS agencies do not have a significant number of systems in the 800 MHz band
- The geographic region of responding local agencies does not appear to have a significant impact on their chosen operating frequency; however, the following points are worth noting
 - East coast agencies use less High-Band VHF than agencies in other regions of the country
 - Responding agencies located in the Mountain/Pacific region are less inclined to operate 800 MHz systems
- Surprisingly, the largest percentage of 800 MHz systems was reported by responding local agencies whose jurisdiction covers more than 10,000 square miles
 - In general, it requires a significant number of towers to provide adequate 800 MHz coverage to a large land area, the costs of which can be significant

Note: Charts showing the distribution of operating frequency by agency mission, geographic region, and jurisdiction size are included in Appendix A

A MAJORITY OF LOCAL AGENCIES SHARE, IN SOME FASHION, THEIR RADIO COMMUNICATIONS RESOURCES WITH OTHER PUBLIC SAFETY AGENCIES

- Nearly 70% of all local respondents indicate sharing with other agencies
 - Agencies broadly define sharing; responses range from using a common radio frequency to using common infrastructure and equipment
 - Approximately two-thirds of the agencies that share indicate that another agency controls the network infrastructure for the radio system they use
- 93.5% of agencies that indicate sharing also report with whom they share
 - Of these respondents, 95.3% share solely with other local agencies
 - One of these local respondents (0.2%) indicates operating on a state-owned shared system
 - The remaining respondents (4.5%) indicate sharing with either state or federal, or a combination of local, state, and federal, public safety agencies
- Local agencies who indicate with whom they share generally share with a limited number of other agencies
 - 50% of local agencies who share do so with one to five other agencies
 - 13.7% shared with 5-15 agencies while only 5.3% share with more than 15 other agencies
 - Note that 31% of the local respondents who indicate sharing did not provide complete or sufficient information to determine the number and types of agencies with whom they share

Note: Charts that analyze sharing information by survey sampling bins are included in Appendix A

Local Agencies' General System Information...Sharing...

THE OPERATING FREQUENCY BANDS AND THE SYSTEM TYPES OF THOSE AGENCIES THAT SHARE MIRROR THE OVERALL PATTERNS FOR LOCAL PUBLIC SAFETY AGENCIES

- A majority (52.8%) of local respondents who share operate in High-Band VHF
 - A limited number (7.1%) who share operate in the 800 MHz band
- An overwhelming number of local sharing is done using conventional analog systems
 - Despite the technical advantages, less than 1% of sharing takes place using trunked digital systems
 - Additionally, only 7.9% of sharing takes place using conventional digital systems

Local Agencies' General System Information...Additional Types of Communications Supported...

MANY OF THE RESPONDING LOCAL AGENCIES WILL NEED TO UPGRADE THEIR RADIO SYSTEMS TO SUPPORT MORE ADVANCED COMMUNICATIONS CAPABILITIES

- In addition to voice communications, paging and data services are the primary types of communications supported by local public safety radio systems
 - A significant number (49.1%) of local LMR systems support paging
 - Only 7.9% of all local respondents currently use their system for data communications
- Imagery and video technologies are just beginning to emerge as useful tools in helping local public safety agencies effectively complete their mission
 - Consequently, very few local respondents are using their radio systems for imagery and video transmissions
- Use of the most advanced types of communications tend to increase as the number of users on the system increase
 - The percentage of data-capable systems greatly increases with the number of users on the system
 - Paging capability is a more widely used technology; therefore, the percentage of paging-capable systems increases more gradually with the number of users on the system

Note: Charts comparing paging and data capabilities by agencies number of users and mission are included in Appendix A

LOCAL RESPONDENTS THAT ARE CURRENTLY USING MORE ADVANCED COMMUNICATIONS CAPABILITIES APPEAR TO BE MIGRATING TOWARD AN UPDATED LMR INFRASTRUCTURE

- Local respondents who indicated that they operate data-capable systems tend to have a more sophisticated radio infrastructure
 - A significant portion (29.4%) of local respondents who have data-capable systems operate in the 800 MHz band
 - A large number of these local respondents (also 29.4%) indicate that their systems are digital
- Of the local respondents that indicated their systems support data communications, a majority state they use mobile data terminals as the primary device for accessing data
 - 86.7% of those who indicated they support data communications use mobile data terminals (MDT); most of these local agencies have greater than 100 users on their system
 - A majority of the 13.3% that use mobile data computers (MDC) are local law enforcement agencies
- Local respondents who indicate that they operate LMR systems that support paging tend to have similar infrastructure characteristics to the overall public safety community
 - Of the respondents who have paging systems, 70% operate in High-Band VHF
 - 89.2% of respondents with paging capability operate conventional analog systems

Note: Charts showing the total number of MDTs and MDCs used by agency mission and number of users are included in Appendix A

IV. LOCAL AGENCIES' USER EQUIPMENT INFORMATION

Local Agencies' User Equipment Information...

THIS SECTION SUMMARIZES LOCAL AGENCY RESPONDENTS' USER EQUIPMENT INFORMATION

- This section covers the following information:
 - Portable Radio Vendors
 - Portable Radio Types
 - Portable Radio Security
 - Mobile Radio Vendors
 - Mobile Radio Types
 - Mobile Radio Security

THE LOCAL PUBLIC SAFETY PORTABLE RADIO MARKET IS PRIMARILY SUPPLIED BY ONE VENDOR

- There may be an opportunity to reduce portable radio costs by increasing market competition
 - Motorola is the portable radio vendor for nearly 60% of local respondents
 - Ericsson is the second largest portable radio vendor, but has only a 6.6% share of the local public safety market
 - Kenwood is the third largest provider of portable radios (4%)
- Local survey responses indicate that there are over fifteen additional portable radio vendors
 - Those vendors appear to fragment the smallest portion of the portable market and offer limited competition to the primary vendor, Motorola
- A significant number of local respondents did not indicate which vendor supplied their portable radio
 - The vendor section of the *LMR Equipment and Infrastructure Survey* was optional

LOCAL RESPONDING AGENCIES INDICATE THEY ARE USING PRIMARILY MID-RANGE PORTABLE RADIOS

- For the purposes of the cost study activity, portable radios were divided into three categories:
 - **Basic portable radios** are capable of supporting less than ten channels and have a limited number of features
 - **Mid-range portable radios** are capable of supporting ten to fifty channels and may have an increased number of features (i.e., keypad, alphanumeric display, or programmable buttons)
 - **High-end portable radios** are capable of supporting more than fifty channels and generally have a number of additional features (i.e., keypad, 7-8 digit alphanumeric keypad, several programmable buttons, phone interconnect, capability for software upgrade)
- Based on local agency survey responses, agency mission appears to impact the level of portable radio sophistication
 - Local law enforcement agencies use the largest percent of high-end portable radios (30.9%)
 - Of responding local EMS/Rescue agencies, only 4.6% use high-end portable radios
- As the number of users on a system increases, local agencies appear to employ a larger percentage of more advanced portable radios
 - Local agencies with greater than 51 users on their system tend to have nearly twice the percentage of high-end portables as those local agencies with 50 or fewer users on the system

Note: Charts comparing the types of portable radios distributed by an agencies mission and number of users are included in Appendix B

RESPONDING LOCAL PUBLIC SAFETY AGENCIES ARE ADDING OPTIONAL FEATURES TO HELP IMPROVE THE SECURITY OF THEIR RADIO SYSTEMS

- Encrypted radios are becoming necessary for local public safety agencies to effectively perform their mission
 - The use of encryption varies only slightly from basic to high-end radios suggesting the addition of this technology to all radios
 - Survey responses indicate that local law enforcement agencies use the highest percentage of encrypted radios
 - Nearly 40% of high-end portable radios are encryption-capable
- Over the air rekeying (OTAR) is a more advanced technology that simplifies the keying process on encrypted radios
 - A significant percentage (nearly 50%) of responding local agencies who have radios with encryption capability also have OTAR

Note: Charts comparing use of OTAR and encryption technology in portable radios by agency mission are included in Appendix B

THE LOCAL MARKET FOR MOBILE RADIOS MIRRORS THE LOCAL MARKET FOR PORTABLE RADIOS

- Most of the responding local agencies use the same vendor for both mobile and portable radios
 - 87.6% of the local respondents that use Motorola portable radios also use Motorola mobile radios
 - 75.9% of the local respondents that use Ericsson portable radios also use Ericsson mobile radios
 - 65.6% of the local respondents that use Kenwood portable radios also use Kenwood mobile radios
- Similar to portable radios, there is limited competition in the mobile radio market
 - Motorola is the mobile radio vendor for over 50% of local respondents
 - Ericsson is the second largest mobile radio vendor, but has only a 7.6% market share of local respondents
- Survey responses indicate that there are over fifteen additional mobile radio vendors
 - These vendors appear to fragment the smallest portion of the mobile radio market and offer limited competition to the primary vendor, Motorola
- A significant number of local respondents did not indicate which vendor supplied their mobile radios
 - The vendor section of the *LMR Equipment and Infrastructure Survey* was optional

RESPONDING LOCAL AGENCIES INDICATE THAT THEY ARE PRIMARILY USING MID-RANGE MOBILE RADIOS

- For the purposes of the cost study activity, mobile radios were divided into three categories:
 - **Basic mobile radios** are capable of supporting less than 20 channels and have low output power (less than 25 watts)
 - **Mid-range mobile radios** are capable of supporting 20-99 channels and have output power of 30-50 watts; they may also have a 2-digit alphanumeric display, may be data capable, and may have programmable buttons
 - **High-end mobile radios** are capable of supporting 100 or more channels and have output power of over 50 watts, they may have an eight digit (or higher) alphanumeric display, be data capable, and have several programmable buttons
- Local agency mission appears to impact the level of mobile radio sophistication
 - Survey responses from local combined fire and EMS/Rescue agencies indicate significantly high use of basic mobile radios (60%)
- The number of users on a system does not appear to affect the type of mobile radio used

Note: Charts comparing the types of mobile radios used by agency mission and number of users are included in Appendix B

RESPONDING LOCAL PUBLIC SAFETY AGENCIES USE ENCRYPTION AND OTAR IN APPROXIMATELY THE SAME PERCENTAGES ON MOBILE AND PORTABLE RADIOS

- As stated earlier, encrypted radios are becoming necessary for local public safety agencies to effectively perform their mission
 - The use of encryption varies only slightly from basic to high-end radios indicating the addition of this technology to all types of radios
 - Survey responses indicate that local law enforcement agencies use the highest percentage of encrypted radios
 - Nearly 40% of high-end mobile radios are encryption capable
- OTAR is a more advanced technology that simplifies the keying process on encrypted radios
 - A significant percentage (nearly 50%) of responding local agencies who have radios with encryption capability also have OTAR

**V. LOCAL AGENCIES' NETWORK EQUIPMENT
INFORMATION**

Local Agencies' Network Equipment Information...

THIS SECTION SUMMARIZES LOCAL AGENCY RESPONDENTS' NETWORK EQUIPMENT INFORMATION

- This section covers the following information:
 - Base Stations
 - Repeaters
 - Antenna Towers
 - Dispatch and Control
 - Automatic Vehicle Locator
 - Computer Aided Dispatch
 - Network Equipment Vendors

AMONG THE LOCAL AGENCIES INDICATING THAT THEY OWN AT LEAST ONE BASE STATION, THE AVERAGE NUMBER OF BASE STATIONS USED INCREASES DRAMATICALLY AS THE REQUIREMENTS FOR THE SYSTEM INCREASE

- The average number of base stations significantly increases when the coverage area is larger than 10,000 square miles
- Similarly, the number of base stations significantly increases when a local agency has more than 100 users on the system
- The average number of base stations is relatively consistent regardless of local agencies' missions
 - Local respondents that indicate they consist of all mission types average nearly six base stations per system
 - Local EMS/Rescue respondents operate the fewest base stations, averaging slightly over one per system
- Most local public safety agencies operate desktop base stations
 - Cabinet mounted 29.8%
 - Rack mounted 11.1%
 - Desktop 59.1%
- A majority of local public safety agencies operate low power LMR base stations
 - Under 100 Watts 64.6%
 - 100 – 149 Watts 28.4%
 - Greater than 150 Watts 7%

AMONG THE LOCAL AGENCIES INDICATING THAT THEY OWN AT LEAST ONE REPEATER, COVERAGE AREA AND SYSTEM SIZE APPEAR TO EFFECT THE NUMBER OF REPEATERS IN THE SYSTEM

- The average number of repeaters increases steadily with the jurisdiction size
 - The most significant growth is seen in local agencies covering between 1,000 and 10,000 square miles
- The average number of repeaters is relatively consistent among local respondents that have less than 100 users
 - The average number of repeaters grows significantly among local agencies that operate systems of greater than 100 users
- Local law enforcement and systems that support multiple missions (All) tend to have the largest number of repeaters
- Repeaters tend to be more securely mounted than base stations
 - Cabinet mounted 48.4%
 - Rack mounted 32.6%
 - Desktop 19%
- Repeaters tend to have higher output power than base stations
 - Under 100 Watts 23.5%
 - 100 – 149 Watts 61%
 - Greater than 150 Watts 15.5%

LOCAL RESPONDENTS WHO OWN AT LEAST ONE TOWER HAVE INDICATED THAT THE NUMBER OF TOWERS USED IS PRIMARILY AFFECTED BY THE SIZE OF THEIR JURISDICTION

- Local agency responses show a positive correlation between the coverage area of a jurisdiction (in square miles) and the number of antennas used in the system
- Additionally, the number of users operating on a system affects the number of towers used
 - The average number of towers remains fairly constant for local systems with less than 100 users, but grows significantly for larger systems with more than 100 users
- A majority of responding local public safety agencies (56.5%) did not indicate that they own their own towers
 - When the local responding sample was analyzed as a whole, the average number of towers owned per system was less than one
 - These local agencies may share systems with other agencies or may lease towers
- Very few of the local respondents (6%) indicate that they use microwave links to interconnect their towers
- Responding local agencies indicate that their antenna towers are constructed in the following manner:

	Percentage of Towers	Average Height of Towers (in feet)
Monopole	10.6%	47
Self-supported (freestanding)	56.8%	64
Guyed (supported by wire)	32.6%	94.6

A LOCAL AGENCY'S SIZE EFFECTS THE NUMBER OF DISPATCH CONSOLES AND DESKTOP CONTROLLERS USED IN THEIR SYSTEM

- The average number of dispatch consoles is fairly consistent for local systems with less than 100 users
 - There is a significant increase in the average number of dispatch consoles in systems with greater than 100 users
- The average number of dispatch consoles is significantly higher for local systems that support multiple missions
 - On average, the local respondents indicate that they have approximately nine dispatch consoles
 - Local respondents with more specific missions consistently report operating approximately two dispatch consoles
- 75% of local respondents' dispatch consoles control between three and five channels
- Local respondents indicate that their dispatch console supports the following additional functions:
 - 38.3% indicate that their console supports a paging encoder
 - 20.5% indicate that their console supports a start-alert signal
 - 14.3% indicate that their console supports supervisory control
 - 2.6% indicate that their console supports Graphical User Interface (GUI)
 - 15.4% indicate that their console supports telephone patching
- Many local respondents use desktop controllers, which provide control over radios and base stations from remote locations, to support their mission
 - The average number of desktop controllers steadily increases with the size of the agency

Note: Charts showing the number of channels and additional functions supported by dispatch consoles are shown in Appendix C

RESPONDING LOCAL AGENCIES ARE BEGINNING TO USE ADVANCED TECHNOLOGIES TO IMPROVE THE EFFICIENCY AND CAPABILITY OF THEIR DISPATCHERS

- The percent of local respondents indicating that they use computer aided dispatch (CAD) increases steadily as the number of users on the system increases
 - Nearly 40% of local respondents with more than 100 users indicate that they use CAD
 - A limited number (less than 5%) of local agencies with less than 25 users support CAD
- Local respondents that support multiple missions are more likely to support CAD systems
- Automatic Vehicle Locator (AVL) technology does not appear to be widespread among the local agencies responding to the survey
 - Less than 1% of responding local agencies indicated use of AVL technology, all of which were agencies with greater than 100 users on their system
 - Local law enforcement and EMS/Rescue are the only types of agencies that indicated use of AVL technology

LOCAL AGENCY RESPONSES DID NOT PROVIDE SUFFICIENT INFORMATION TO ASSESS THE STATE OF VARIOUS NETWORK EQUIPMENT MARKETS

- Fewer local respondents provided information about their repeater and base station vendors than they did about their portable and mobile radio vendors
 - Over 40% of local respondents did not indicate the vendor for their repeaters and base stations
 - Of the local respondents that indicated base station and repeater vendors, Motorola appeared to have the most substantial amount of the market
- Responses to survey questions about console vendors were more incomplete than questions about repeater and base station vendors
 - Nearly 60% of local respondents did not indicate the vendor for their dispatch console
 - Of the local respondents who did indicate a console vendor, Motorola appeared to be agencies' primary vendor
 - Ericsson and Orbacom also supplied dispatch consoles to respondents, but neither appeared to have a significant percentage of the market
- Similar to questions about portable and mobile radio vendors, the responses to questions about network equipment vendors were optional

**VI. STATE AGENCIES' GENERAL SYSTEM
INFORMATION**

State Agencies' General Systems Information...

THIS SECTION SUMMARIZES STATE AGENCY RESPONDENTS' GENERAL SYSTEMS INFORMATION

- This section covers the following set of system information:
 - State Agency Demographics
 - System Type
 - Operating Frequency
 - Shared Systems
 - Additional Types of Communications Supported

SURVEY RESPONSES FROM STATE PUBLIC SAFETY AGENCIES WERE CATEGORIZED BY MISSION, GEOGRAPHY, AND COVERAGE AREA

- Responding state agencies are classified into four mission types with the following distribution:
 - Law Enforcement 29.9%
 - Department of Public Safety 25.8%
 - Fire/EMS 22.7%
 - Emergency Management 21.6%
- Responding state agencies were grouped into four geographic regions that were established by combining the nine United States census regions:
 - East Central (East North Central/East South Central) 16.5%
 - East Coast (Mid-Atlantic/South Atlantic/New England) 21.5%
 - Mountain/Pacific 36.1%
 - West Central (West North Central/ West South Central) 25.8%
- State agencies' coverage area was determined by grouping the known square mileage of each state into the following four groups:
 - Less than 25,000 square miles 9.3%
 - 25,000 to 50,000 square miles 18.6%
 - 50,000 to 100,000 square miles 40.2%
 - Greater than 100,000 square miles 32.0%

STATE AGENCIES, LIKE LOCAL AGENCIES, WILL NEED TO DEDICATE SIGNIFICANT FINANCIAL RESOURCES TO MODERNIZATION IF THEY WISH TO MIGRATE TO DIGITAL SYSTEMS

- A smaller percentage of state agencies than local agencies use digital technology
 - Approximately 7% of responding state agencies operate digital systems
 - Of those with digital systems, 82.6% operate conventional systems and 17.4% operate trunked systems
 - Just over 93% of all responding state agencies report operating analog systems
- Responding state agencies have not made large-scale moves to replace conventional analog technology
 - Over 80% of responding state agencies within each mission type currently operate conventional analog systems
 - All responding state emergency management agencies indicate use of conventional analog systems
 - Approximately 10% of state law enforcement agencies and state departments of public safety indicated that they now use conventional digital technology
- Only 1.1% of all responding state agencies report using trunked systems, all of which are also digital systems
 - Only state fire/EMS agencies reported that they use trunked technology

Note: A chart showing the distribution of system types by agency mission is included in Appendix D

A MAJORITY OF STATE AGENCIES CONTINUE TO OPERATE THEIR LMR SYSTEMS IN HIGH-BAND VHF

- Survey responses show similar percentages of state and local agencies operating in the High-Band VHF and 800 MHz bands
 - 52.3% of state agencies indicate High-Band VHF operations while only 8.1% operate in 800 MHz
 - A significant number (29.1%) of responding state agencies are operating in low-band VHF
- The mission of respective state agencies does not appear to impact their selection of a frequency band, although the following cases were noted:
 - Nearly 80% of responding state law enforcement agencies operate in either Low-Band or High-Band VHF
 - State fire/EMS agencies have the highest percentage (14.3%) of 800 MHz systems
 - State emergency management agencies did not appear to operate any 800 MHz systems
- Operating frequency varies among responding state agencies from differing geographic regions
 - In both the Mountain/Pacific and the West Central regions, over 60% of respondents operate in high-band VHF
 - The East Coast region operates primarily (47.1%) in Low-Band VHF
 - The East Central region has the highest percentage of responding state agencies (14.3%) operating in the 800 MHz band
- Survey responses indicate that state agencies in larger jurisdictions tend to operate in the High-Band VHF
 - Only 14.3% of responding state agencies from jurisdictions less than 25,000 square miles operate on a High-Band VHF, while over 65% of state respondents covering over 100,000 square miles operate in High-Band VHF
 - 14.3% of the state respondents with jurisdictions covering less than 25,000 square miles operate in the 800 MHz band, no respondents in jurisdictions greater than 100,000 square miles operate in the 800 MHz band

Note: Charts showing the distribution of operating frequency by agency mission, geographic region, and jurisdiction size are included in Appendix D

WIDESPREAD SHARING OF LMR SYSTEMS DOES NOT APPEAR TO EXIST AT THE STATE LEVEL

- 27% of all state respondents indicate that they operate and maintain a statewide LMR system for all state public safety agencies
- A majority (37%) of state survey respondents participate in state systems but also continue to operate their own systems
 - 28% of responding state agencies maintain their own systems and do not participate in a broader system
 - 8% of responding state agencies indicate that they are responsible for only their user equipment (these agencies may have partnerships with either private service providers or other public safety agencies who own and maintain the LMR system)
- Many (45%) of those who operate statewide systems for all public safety agencies operate in High-Band VHF
 - A significant portion (over 30%) operate in Low-Band VHF
 - 15% operate in the 800 MHz band
- As with local systems, most of the shared statewide systems are conventional analog
 - Over 80% of the shared state systems are analog
 - 15% of the shared systems are digital, and a third of those are trunked

State Agencies' General System Information...Additional Types of Communications Supported...

IT APPEARS RESPONDING STATE AGENCIES ARE BEGINNING TO IMPLEMENT MORE ADVANCED TECHNOLOGIES AND CAPABILITIES

- The use of paging and data technology is becoming more prominent among state public safety agencies
 - Nearly 20% of responding state agencies have paging capability
 - Only about 6% of state respondents currently use their system to support data communications
- Some state public safety agencies did not indicate use of any additional types of communications
 - Responding state fire/EMS agencies indicate no use of either paging or data communications
 - Responding state departments of public safety did not report any use of data
- As with local public safety agencies, responding state agencies use of video and imagery technology is nominal
 - 2.1% of state survey respondents use their system to support imagery transmission
 - Only 1% of responding state agencies report using their LMR system for video transmission

Note: Charts comparing paging and data capabilities by agency's mission are included in Appendix D

RESPONDING STATE AGENCIES USING MORE ADVANCED COMMUNICATIONS CAPABILITIES ALSO TEND TO OPERATE A MORE UPDATED LMR INFRASTRUCTURE

- State respondents who indicate they operate data-capable systems also tend to have more a sophisticated LMR infrastructure
 - A significant percentage (50%) of responding state agencies with data-capable systems operate in the 800 MHz band
 - Additionally, 50% of the responding state agencies with data-capable systems indicate that their systems are digital
- State agencies appear to operate more mobile data computers (MDC's) than mobile data terminals (MDT's)
 - Twice the number of state law enforcement agencies use MDC's as MDT's
 - Three times the number of state emergency management agencies use MDC's as MDT's
- Similar to local agencies, survey responses indicate that the LMR infrastructure characteristics of state agencies supporting paging communications are more reflective of the overall public safety community
 - Of those state respondents with paging systems, 62.5% operate in High-Band VHF
 - 93.8% of respondents with paging systems operate conventional analog systems

**VII. STATE AGENCIES' USER EQUIPMENT
INFORMATION**

State Agencies' User Equipment Information...

THIS SECTION SUMMARIZES STATE AGENCY RESPONDENTS' USER EQUIPMENT INFORMATION

- This section covers the following information:
 - Portable Radio Vendors
 - Portable Radio Types
 - Portable Radio Security
 - Mobile Radio Vendors
 - Mobile Radio Types
 - Mobile Radio Security

THE STATE PUBLIC SAFETY PORTABLE RADIO MARKET, LIKE THE LOCAL MARKET, IS PRIMARILY SUPPLIED BY ONE VENDOR

- There may be an opportunity to reduce portable radio costs through increased market competition
 - Motorola is the primary portable radio vendor for 50.5% of responding state agencies
 - Ericsson is the second largest portable radio vendor, but has slightly over 10% market share
 - No state respondents indicated that they use Kenwood portable radios; instead, Bendix-King is the third-largest provider of portable radios (7.2%) to responding state agencies
- State agencies indicated that they only use two other portable radio vendors
 - These vendors do not have a significant market share (2%) and do not appear to offer competition to the three largest portable radio vendors
- Nearly 30% of state survey respondents did not indicate which vendor supplied their portable radios
 - The large percentage of those who did not answer could significantly change the market analysis
 - The vendor section of the *LMR Equipment and Infrastructure Survey* was optional

RESPONDING STATE AGENCIES APPEAR TO BE USING MORE HIGH-END PORTABLE RADIOS THAN THEIR LOCAL COUNTERPARTS

- The cost study activity grouped the types of portable radios into three categories: basic, mid-range, and high-end
 - Descriptions of these three categories are included on page IV-3
- The percentage of state respondents that operate mid-range portable radios is significantly lower than the percentage of local respondents operating mid-range radios
 - The percentage decrease in state agency use of mid-range radios is offset by an significantly higher percent (34%) indicating that they operate high-end portable radios
 - The percentage of state respondents (25%) indicating use of basic portable radios is also higher than for local respondents
- The mission of responding state agencies appears to effect the level of sophistication of their portable radios
 - State law enforcement and emergency management agencies have a fairly equal distribution between basic, mid-range, and high-end portable radios
 - State departments of public safety operate very few high-end radios (2.4%); however, they operate nearly the same percentages of basic and mid-range radios

Note: A chart showing the types of portable radios used by mission is included in Appendix E

RESPONDING STATE AGENCIES ALSO APPEAR TO BE ADDING ADDITIONAL SECURITY FEATURES TO MANY OF THEIR RADIOS

- As with local survey respondents, the use of encrypted radios are becoming necessary for state respondents to effectively perform their mission
 - Over 40% of respondents with each type of radio (basic, mid-range, high-end) indicate that their radios have encryption capabilities
 - Nearly 60% of state respondents' high-end portables are encryption-capable
 - State law enforcement and emergency management appear to have the largest percentages of encrypted radios
 - With approximately 20% of their radios encryption-capable, state fire/EMS agencies appear to use the least amount of encrypted communication
- Responding state agencies appear to be using equivalent percentages of OTAR regardless of the level of sophistication of their portable radios
 - State departments of public safety operate the largest percentage of OTAR-capable radios
 - Over 50% of state departments of public safety that have encryption-capable radios also have OTAR-capable radios
 - State fire agencies did not indicate any use of OTAR

Note: Charts comparing the use of OTAR and encryption technology by agency mission are included in Appendix E

THE LARGE NUMBER OF RESPONDENTS WHO DID NOT INDICATE A MOBILE RADIO VENDOR MAKE IT DIFFICULT TO DRAW ANY SIGNIFICANT CONCLUSIONS ABOUT THE STATE PUBLIC SAFETY MOBILE RADIO MARKET

- Over 40% of the state agency respondents did not indicate which vendor supplied their mobile radios
 - The vendor section of the *LMR Equipment and Infrastructure Survey* was optional
- Among the state agencies who provided their mobile radio vendors, the market appeared to mirror the state's portable radio market
 - Motorola is the mobile radio vendor for more than 36% of state respondents
 - Ericsson is the second largest mobile radio vendor with 14.4% of market share of state respondents
 - Midland is the third largest provider of mobile radios (3.1%)
- Many of the responding state agencies use the same mobile vendor as portable vendor
 - 90% of the state respondents that use Ericsson portable radios also use Ericsson mobile radios
 - 65.3% of the state respondents that use Motorola portable radios also use Motorola mobile radios
 - None of the respondents that use Bendix-King portable radios use Bendix-King mobile radios; Bendix-King does not appear to manufacture mobile radios

RESPONDING STATE AGENCIES INDICATE THAT THEY USE A SIGNIFICANT NUMBER OF HIGH-END MOBILE RADIOS

- The cost study activity grouped the types of mobile radios into three categories: basic, mid-range, and high-end
 - Descriptions of these three categories are included on page IV-6
- Approximately two-thirds of all state respondents indicate that they use high-end mobile radios
 - Only a small percentage (6%) of respondents radios are classified as basic
 - State respondents appear to operate significantly lower percentage of mid-range mobile radios than their local counterparts
- The mission of responding state agencies appears to have a dramatic effect on the level of sophistication of their mobile radios
 - Over 85% of state law enforcement agencies indicate that they operate high-end mobile radios
 - Only about 1% of state departments of public safety indicate that they operate high-end mobile radios; instead, the majority (92.1%) report using mid-range mobiles
 - Emergency management agencies have a more even distribution of radio types, although they appear to use more mid-range mobile radios

Note: A chart showing the types of portable radios used by mission is included in Appendix E

RESPONDING STATE PUBLIC SAFETY AGENCIES USE ENCRYPTION AND OTAR IN SIMILAR PERCENTAGES ON THEIR MOBILE RADIOS AS ON THEIR PORTABLE RADIOS

- The use of encryption does not vary significantly by type of radio (basic, mid-range, high-end)
 - Over 40% of state respondents operating either basic or high-end mobile radios use encryption technology
 - A slightly lower percentage (28.8%) of mid-range mobiles are encryption capable
- State respondents appear to be in the initial stages of adding OTAR to their LMR systems
 - As a percentage, state respondents with high-end mobiles appear to use the least amount of OTAR-capable radios
 - Nearly the same percentage of state departments of public safety that report supporting encryption on their mobile radios also report using OTAR
 - Neither state emergency management or fire/EMS agencies indicate that they use OTAR on any of their mobile radios

Note: Charts comparing the use of OTAR and encryption technology by agency mission are included in Appendix E

**VIII. STATE AGENCIES' NETWORK EQUIPMENT
INFORMATION**

State Agencies' Network Equipment Information...

THIS SECTION SUMMARIZES STATE AGENCY RESPONDENTS' NETWORK EQUIPMENT INFORMATION

- This section covers the following information:
 - Base Stations
 - Repeaters
 - Antenna Towers
 - Dispatch and Control
 - Automatic Vehicle Locator
 - Computer Aided Dispatch
 - Network Equipment Vendors

OF THE STATE AGENCIES INDICATING THAT THEY OWN AT LEAST ONE BASE STATION, THE AVERAGE NUMBER OF BASE STATIONS INCREASES WITH THE SIZE OF THE STATE

- The average number of base stations increases significantly when the state's coverage area is greater than 100,000 square miles
- The average number of base stations is relatively consistent across all state mission types
 - State fire/EMS agencies operate more base stations (over 80) on average than other state agencies
- A majority of state agencies' base stations are rack mounted
 - Cabinet mounted 36.7%
 - Rack mounted 40.8%
 - Desktop 22.5%
- Nearly equal percentages of state agencies operate low-power (under 100 watts) and mid-power (100-149 watts) base stations
 - Under 100 Watts 45.9%
 - 100 – 149 Watts 46.3%
 - Greater than 150 Watts 7.8%

STATE SURVEY RESPONSES DO NOT REFLECT A CLEAR, OR CONSISTENT, CORELLATION BETWEEN THE SIZE OF THE STATE AND THE NUMBER OF REPEATERS

- Of the responding state agencies indicating that they own at least one repeater, the average number of repeaters tends to decrease as the size of the state increases
 - The number of repeaters does not decrease in a distinguishable linear pattern with a state's coverage area
 - The number of repeaters in small states may be inflated because the state of New Jersey has considerably more repeaters than other responding small states
- State law enforcement agencies tend to have the largest average number of repeaters while the number of repeaters for other state agencies (emergency management, fire/EMS, and department of public safety) tend to remain consistent
- State agencies indicate nearly an equal split of cabinet and rack mounted repeaters
 - Cabinet mounted 48.8%
 - Rack mounted 49.6%
 - Desktop 1.6%
- Most state agencies operate low-power (under 100 watts) repeaters
 - Under 100 Watts 44.2%
 - 100 – 149 Watts 32.6%
 - Greater than 150 Watts 23.2%

State Agencies' Network Equipment Information...Antenna Towers...

OF THE STATE AGENCIES INDICATING THAT THEY OWN AT LEAST ONE ANTENNA TOWER, THE NUMBER OF TOWERS OWNED VARIES BASED ON JURISDICTION SIZE AND AGENCY MISSION

- State survey responses show a direct correlation between the number of towers and the states coverage area
- The missions of responding state agencies dramatically effects the number of towers owned
 - State law enforcement and fire/EMS agencies own nearly 60 tower on average
 - Alternatively, state emergency management agencies and departments of public safety own, on average, less then three and twenty antenna towers respectively
- A much larger percentage (48%) of state respondents than local respondents indicate that they use microwave technology to interconnect their towers
- Responding state agencies indicate that their towers are constructed in a similar manner to local agencies

	Percentage of Towers	Average Height of Towers (in feet)
Monopole	30.4%	69
Self-supported (freestanding)	67.7%	119.3
Guyed (supported by wire)	1.8%	177.3

Note: Charts showing the number of antenna towers by geographic region are shown in Appendix F

STATE AGENCIES' MISSION AND COVERAGE AREA EFFECT THE NUMBER OF DISPATCH CONSOLES AND DESKTOP CONTROLLERS USED IN THEIR SYSTEM

- The number of dispatch consoles fluctuates with a state agencies' coverage area
 - The number of owned consoles peaks (approximately 25 consoles) for states covering 25,000-50,000 square miles
- Over 40% of state respondents' dispatch consoles control 5 channels
- State respondents indicate their consoles support more functions than local respondents
 - Over 30% report that their console supports paging-encoding, start-alert signaling, and telephone patching
 - Over 40% report that their console supports supervisory control
 - Approximately 15% report that their console supports graphical user interface (GUI)
- State emergency management and fire /EMS agencies use significantly more desktop controllers than state law enforcement and public safety departments
 - State emergency management and fire/EMS agencies report using 100 desktop controllers on average
 - Conversely, state law enforcement agencies report using approximately 20 desktop controllers on average

Note: Charts showing the number of channels and additional functions supported at the dispatch console are shown in Appendix F

State Agencies' Network Equipment Information...AVL and CAD...

RESPONDING STATE AGENCIES DO NOT APPEAR TO BE USING ADVANCED TECHNOLOGIES TO SUPPORT THEIR DISPATCHERS

- Very few state respondents indicated use of Automatic Vehicle Locator (AVL) technology
 - State law enforcement agencies were the only respondents to report using AVL
- State law enforcement agencies are the most likely to support CAD systems

STATE AGENCY RESPONSES, LIKE LOCAL AGENCY RESPONSES, PROVIDED LIMITED INSIGHT ABOUT NETWORK EQUIPMENT VENDORS

- State respondents did not provide as much information about their base station and repeater vendors
 - Over 40% of state respondents did not indicate the vendor for their repeaters and base stations
 - Of the state respondents that indicated base station and repeater vendors, both Motorola and Ericsson appeared to have a substantial customer base
- State responses about console vendors were as equally limited as the local responses
 - Over 50% of state respondents did not indicate the vendor for their dispatch console
 - Of the state respondents who did indicate a console vendor, Motorola again appeared to be agencies' primary vendor
 - As with local agencies, Ericsson and Orbacom also supplied dispatch consoles to state respondents, but neither appeared to have a significant percentage of the market
- Similar to questions about portable and mobile radio vendors, the responses to questions about network equipment vendors were optional

**APPENDIX A: ADDITIONAL BACKGROUND ON
LOCAL AGENCIES' GENERAL SYSTEMS
INFORMATION**

**APPENDIX B: ADDITIONAL BACKGROUND ON
LOCAL AGENCIES' USER EQUIPMENT
INFORMATION**

**APPENDIX C: ADDITIONAL BACKGROUND ON
LOCAL AGENCIES' NETWORK EQUIPMENT
INFORMATION**

**APPENDIX D: ADDITIONAL BACKGROUND ON
STATE AGENCIES' GENERAL SYSTEM
INFORMATION**

**APPENDIX E: ADDITIONAL BACKGROUND ON
STATE AGENCIES' USER EQUIPMENT
INFORMATION**

**APPENDIX F: ADDITIONAL BACKGROUND ON
STATE AGENCIES' NETWORK EQUIPMENT
INFORMATION**